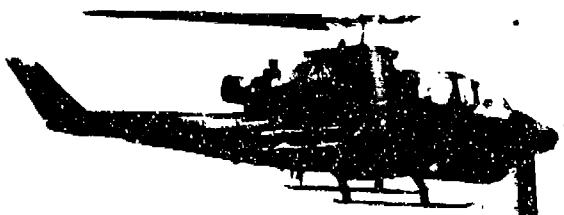

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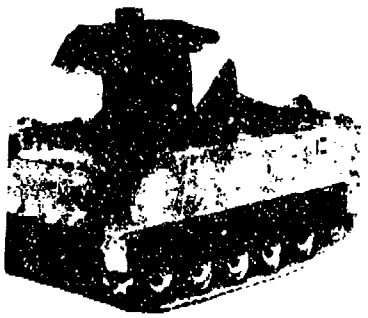
LEVEL II

UH-60A BLACKHAWK



M901 ITV

FIELDING ARMY WEAPON SYSTEMS: EXPERIENCES AND LESSONS LEARNED

BY
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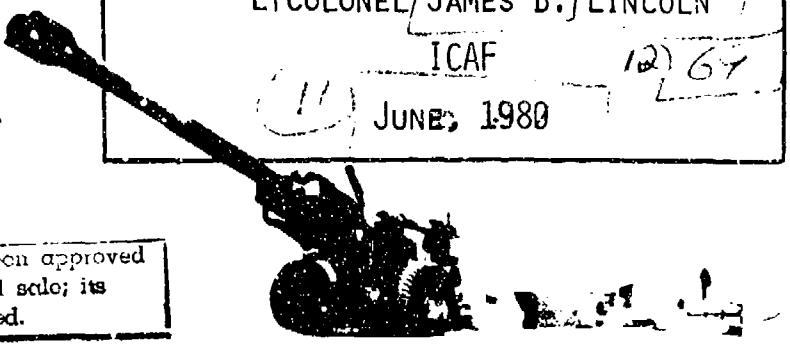
JUNE 1980

CHAPARRAL

M60A3



M198 HOWITZER

TACFIRE

M551 SHERIDAN

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ABSTRACT OF STUDENT RESEARCH REPORT
INDUSTRIAL COLLEGE OF THE ARMED FORCES

NAME OF RESEARCHER (S)	TITLE OF REPORT
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ABSTRACT

During the 1970s, the Army fielded few new weapon systems, as many development programs were stretched out because of the lack of funds to support production and fielding. The resulting "bow wave" of new systems scheduled for fielding in the next few years presents a major challenge to the Army. Recently fielded systems present valuable lessons learned that can assist the Army in preparing for the multiple fieldings scheduled for the next five years. Systems that provide lessons learned include:

- M551 Sheridan;
- M60A2 and A3 Tank;
- Vulcan/Chaparral System;
- M198 Howitzer;
- Improved TOW Vehicle, M901;
- TACFIRE;
- Black Hawk Helicopter;
- AH-1S Cobra Helicopter; and
- TSQ-73 Missile Minder.

Lessons learned were categorized into the following areas:

- Selected ILS activities,
- New materiel release requirement,
- Operational testing,
- TRADOC System Managers,
- Impact of fielding on the command/unit, and
- Contractor maintenance support.

Conclusions and recommendations include a suggestion that Department of Army develop a fielding policy by expanding the current effort to prepare a revised Army regulation on Integrated Logistics Support.

THIS ABSTRACT IS UNCLASSIFIED

FOREWORD

This paper was motivated by the author's experience in fielding the M-198 howitzer, 1977-79. The importance of the process, its complex problems, and lessons learned were therefore understood through direct experience. The analysis and study have revealed, as reported herein, a virtual Pandora's box, exposing a series of problems that have plagued the fielding of equipment in recent years. Also like Pandora's box, the study exposes a real hope for major improvements as the Army becomes more conscious of the need for special attention and for special measures to insure that the fielding of equipment is effectively managed. Without more effective management, the unprecedented modernization effort of the 1980s may result in only a limited improvement in our readiness. This paper does not pretend to tell the whole story nor prescribe a panacea. Its message is best expressed by the words of the best known of the Lincolns:

> "The dogmas of the quiet past are inadequate for the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew, and act anew. We must disenthrall ourselves."
>
> Abraham Lincoln -- 1862 Message to Congress

I. INTRODUCTION

For the past decade, the Army has been spending about two billion dollars a year on R&D. Until recently this huge investment has resulted in little payoff in modernizing the Army. In the face of the stark realization that we are inferior, equipment-wise, to our potential enemies, the long overdue equipment modernization has finally begun. In a recent joint statement to the Congress, the Army's senior civilian and military heads of research, development and acquisition summed up the situation:

> At this point, the US Army is ... from an equipment point of view...second rate.... But we have within a period of three to four years, the opportunity to transform /the Army/ into one that is competitive with the Armies of our potential enemies.[1]

But the modernization process is far more significant than a five-year changeover in equipment at the cost of some $30 billion. Dynamic changes in the enemy threat, in technology and our national strategy lead to development and fielding of new systems with accompanying changes in tactics, doctrine, training and support concepts. Systems are now developed as part of an integrated battlefield concept, so that changes or delay in any one system can cause a chain reaction of adverse impacts. The challenge we face was highlighted and measured by the Army's Chief of Staff, General Edward C. Meyer, when he said "...it will be a tremendous problem to bring in all this equipment - the greatest problem, in my view, that the Army has ever faced."[2]

After the affordability question is resolved, a major issue remains - the challenge of accomplishing an efficient fielding of

each new system without a major disruption of our field units. After years of development and testing and the expenditure of millions of dollars to prepare the system for fielding, the process of handing over the new equipment to the unit to be equipped would seem rather straightforward. But from the perspective of the receiving unit and its tactical and logistical supporters, the process can be very complex, burdensome, and costly. The changeover can also degrade readiness, despite the introduction of a new weapon system with increased capability. Clearly, the introduction process is of basic importance if the Army wants to insure early improvement in capabilities, as opposed to possible temporary deterioration.

The Bow Wave Problem

As a ship increases speed, a wave of water builds up at the bow, limiting the speed of the ship. The Army has its own "bow wave" in the form of a build-up of new systems, all in the fight for limited resources. The double impact of continuing Vietnam expenses and mounting costs arising from complexity and inflation delayed the development of many systems. The effect of Vietnam carried over to the early 1970s, as the Army was able to field only the most needed systems, such as LANCE, Vulcan/Chaparral, Dragon and TOW. The Army also experienced technical problems while developing several badly needed systems such as the new main battle tank, an Infantry combat vehicle, and a new armed attack helicopter. After being cancelled, these three systems were redefined and started again, thus causing "ripples" that added to the present day bow wave of more than 40 major systems and several hundred smaller systems scheduled for fielding in the next five years.

We have already experienced the first year of the bow wave, as 1979 saw the fielding of several new systems. These included TACFIRE, M198 Howitzer, BlackHawk helicopter, and TSQ-73 Missile Minder. Other systems, also fielded in 1979, that provided major new capabilities, but were "product improvements" of an existing system, included the M60A3 tank and Improved TOW Vehicle (ITV), M901. By 1979, the upgunned and modernized Cobra helicopter, the AH-1S, had been fielded in both Europe and CONUS.

Although the Army acknowledges that it cannot afford all of the systems scheduled for fielding, it has apparently rejected terminating lower priority programs and increasing the buys of higher priority ones. The Army has also informed Congress that it must fund and field all planned systems for two major reasons. First, the systems represent an interdependent combined arms team, all of which are essential to achieve the necessary combat power on the battlefield. Second, the defense industrial base must be equipped and refurbished to a capacity level that could be rapidly expanded in case of war. These points, and the critical question of how multiple fieldings can be afforded, were addressed in the Army's most recent statement to the House Armed Services Committee on Feb. 26, 1980:

> If we are to buy all the systems we are requesting today, and stay within the resources we can reasonably expect to be available to us over the next five years, we will have to buy some systems at less than the Optimal economic rate.... What we propose to do is to buy the highest priority systems at the highest rate we can, and the lower priority systems at the minimum economic rate.[3]

Importance of the Fielding Process

However strong and dramatic the efforts in the crucial areas of design trade-offs, training, and logistic support, the entire spectrum of impacts will focus on the fielding process. The importance of the process and our own recent experiences make the process of fielding systems worthy of review and analysis for several reasons. First, the recent systems experienced varying degrees of success when fielded. The Army was reminded that the fielding process is far more than a simple hand-off of the new equipment to the gaining command and first unit. Second, most of the complex procedures and regulations related to the fielding process were first applied with these systems. Finally, a large number of systems will be fielded in the next five years, indicating that a definitive assessment of the process, based on the experiences of the 1970s, should be accomplished.

While the development and production phases of the weapon acquisition process have been studied and restudied, resulting in countless procedures, regulations and guidelines to assist the acquisition manager at every step, the fielding process itself has not been studied. There are few lessons learned from studies or follow-up reports on recent fieldings that could be used to prevent a repetition of problems. It was not until 1976 that a user "hand-off" concept was implemented with the fielding of the M-60A2 tank in Europe. Specific materiel fielding guidelines were established in 1977, but only as part of the overall subject of Integrated Logistics Support (ILS).[4] In early 1980, DARCOM is about to publish a pamphlet on the subject of materiel fielding,[5] but its scope is limited to DARCOM activities and is by no means a comprehensive guide to the total process.

Methodology

This paper cannot be considered a comprehensive and definitive assessment of the materiel fielding process. However, as an initial catalog of problems experienced and analysis with lessons learned, it is written primarily to stimulate follow-on studies and specific corrective actions. The research effort was most challenging because there are few systems that have provided any after-action reports or lessons learned on the fielding experience. Project offices retain very little information on past activities. The task was at times haphazard because of the absence of any overall established system or procedure that would have insured the recording and documenting of the type of information needed.

Information for the paper was collected through numerous letters, phone calls and interviews. References on the fielded systems included materiel fielding plans, test reports from the Operational Test and Evaluation Agency (OTEA), new materiel release files on each system and data from the Army Modernization Information Memorandum (AMIM). Other data were obtained from project memos, reports, and replies to letters sent by the author to project offices, TRADOC System Managers (TSM), commanders of IOC units, and force modernization offices.

Basic Concepts

Contributing to the difficulties experienced during the planning for fielding is the lack of understanding of the key activities and terms related to the fielding process. The least understood concept is the most critical event in the life cycle of the system -- IOC.

Initial Operational Capability (IOC) is the culmination of the development and initial production process, and is defined as follows: (DA PAM 700-127)

a. First unit equipped with required quantities of production items
b. Unit personnel adequately trained to operate, care for, maintain and support the item in the field
c. Materiel fielding plan distributed and materiel fielding team deployed
d. At or above 90% fill of both range and quantity of repair parts, special tools, test measurement diagnostic equipment (TMDE), and calibration equipment
e. Technical publications on hand, final MOS decision announced, TOE approved by HQDA, new equipment training completed, training aids and devices issued, and soldiers' manuals and ARTEP approved and issued.

The key events essential to achievement of the Initial Operational Capability include:

Manufacturing (Production) of required end items, repair parts and other initial support items necessary for initial and sustained operation of the complete system in field units.

Materiel Testing of production items, to include development/engineering tests, and some form of operational test, such as Operational Test III (OTIII), Follow-On Evaluation (FOE), or Force Development Test Experimentation (FDTE). Operational tests are usually conducted by the Operational Test and Evaluation Agency (OTEA), while development tests are normally conducted by the Test and Evaluation Command (TECOM).

Release of materiel for issue (DARCOM Reg 700-34) requires that new systems receive a release certification to insure suitability for troop use in terms of quality, safety, performance, reliability, and supportability. The Commander, Test and Evaluation Command (TECOM) is required to provide a "suitability for issue" statement as part of the release action. This statement is based on adequacy

of materiel performance during tests conducted by TECOM. (The actual readiness of field units and the receiving command to operate and maintain the equipment is not directly considered in this release, and is not the responsibility of DARCOM.)

Achieving IOC

A successful IOC requires far more than accomplishing these basic activities. The acquisition community must accomplish a wide range of activities over a period of years that require careful coordination and the cooperation of numerous agencies. A "critical path" exists, though not always clearly known or charted. If any one critical path event is delayed, an on-time IOC will not be possible.

IOC dates are often established as "best estimate" projections of the earliest possible date that initial fielding can be accomplished, and the program manager is faced with the difficult task of executing a highly optimistic and success-oriented schedule that has little or no margin for delay or "unknown-unknowns."

Difficulties associated with the "rush" to achieve IOC bring about some of the lessons learned, to be discussed in this paper. The process can be characterized as the antithesis of Parkinson's Law. Instead of work expanding to fill the time allotted for its execution, too much work must be compressed into too little time in order to meet an inflexible completion date. An important lesson learned stems from this "time squeeze" situation. After establishing a fielding date that is little more than a highly optimistic projection, the PM feels compelled to achieve that date, despite the problems and shortcomings that may exist when that "magic" date arrives. Furthermore, the date is advertised to OSD, Congress, and, of course, the

user. Nonachievement of the date is tantamount to failure. But the price of success in these cases can be fielding of a system that is not ready to be placed in the hands of the first unit. This is not to say that flexible IOC dates are the answer. Such an approach would have a tendency to result in delaying IOC to the latest possible date, because of the effect of removing a hard deadline. The basic concept of IOC, summarized here and only briefly discussed in the paper, is in need of a comprehensive review all its own.

TRADOC System Managers

A new concept that has significant impact on the fielding process is the TRADOC System Manager (TSM) concept. The TSM is the counterpart of the project manager on the user side. He works for the Commanding General, TRADOC, through the appropriate school/center commander, and is responsible for personnel, training, employment concept, and user-oriented logistic requirements of the new system. He is the focal point representing the user, and works with the PM in a complementary fashion on all aspects of development, testing, and fielding.

Acronyms

AMIM - Army Modernization Information Memorandum
ARRCOM - Armament Readiness Command
ASARC - Army Systems Acquisition Review Committee
ASL - Authorized Stockage List
BII - Basic Issue Items
CDC - Combat Development Command
CERCOM - Communications-Electronics Readiness Command
CONARC - Continental Army Command
CONUS - Continental United States
DARCOM - Materiel Development and Readiness Command
DAPR - Department of Army Program Review
DCSLOG - Deputy Chief of Staff, Logistics
DS - Direct Support
DT - Development Test
ERADCOM - Electronics R&D Command
FORSCOM - Forces Command

GS - General Support
ITDT - Integrated Technical Documentation and Training
IFV - Infantry Fighting Vehicle
ITV - Improved TOW Vehicle
ILS - Integrated Logistic Support
IOC - Initial Operational Capability
LOGCAP - Logistics Capability Assessment Program
MFA - Materiel Fielding Agreement
MFT - Material Fielding Team
MLRS - Multiple Launch Rocket System
MOU - Memorandum of Understanding
MOS - Military Occupational Specialty
NETT - New Equipment Training Team
NICP - National Inventory Control Point
NSN - National Stock Number
OSD - Office, Secretary of Defense
OT - Operational Test
OTEA - Operational Test and Evaluation Agency
PLL - Prescribed Load List
RAM - Reliability, Availability, Maintainability
RSI - Rationalization, Standardization, Interoperability
SLAC - Support List Allowance Cards
SOQAS - Statement of Quality and Support
SPAS - Skill Performance Aids
TM - Technical Manual
TMDE - Test, Measurement, Diagnostic Equipment
TOE - Table of Organization and Equipment
TRADOC - Training and Doctrine Command
TSM - TRADOC System Manager
TSARCOM - Troop Support and Aviation Readiness Command
USAREUR - US Army Europe

II. PAST EXPERIENCES

Before considering the more recently fielded systems, it is worthwhile to consider systems fielded in years past. Examples were selected for two reasons. First, some limited documentation was available for the systems selected, and second, the systems to be discussed present valuable lessons. Many of the lessons cannot be classified as lessons learned since a repetition of problems continues to occur.

Sheridan/Shillelagh Weapon System

In the early 1960s, the Army embarked on a three-part tank development program that utilized a radical new concept of a guided, low velocity, 152mm projectile, with a combustible cartridge case. The program included the M551 Sheridan vehicle, a modified M60A1 tank, and the MBT-70 German-American tank program. The concept was based on commonality of ammunition (with the obvious benefits) and a tank killing capability that would "meet the threat" of the 1970s.

The Sheridan design represented a radical change from armored vehicles of the past. Besides firing the guided projectile, the vehicle would be lightweight, swimmable, and airdroppable, and would achieve greatly improved mobility. From the start, development of the system encountered major problems, particularly with the ammunition. The vehicle was approved for production, despite numerous technical problems and incomplete test results. In 1969, the M551 was deployed to Vietnam to meet an "urgent" field requirement. By 1970, 1650 vehicles had been produced, the program had

cost over $1 billion, and most of the vehicles were in storage awaiting modifications to make them acceptable for fielding.

The vehicle was modified by 1975 and became the M551A1 with the addition of a laser range finder. Also in 1975, a major product improvement program (PIP) was initiated in order to eliminate the numerous technical and maintenance problems that had plagued the vehicle since fielding. But in 1978, the Army decided to withdraw the vehicle from the active inventory,[6] with a plan to use some 330 vehicles as non-firing training tanks at the new National Training Center.

Although the remaining 1110 vehicles are being considered for a possible role in the Rapid Deployment Force, the Army paid a very high price for a short-lived, trouble-plagued combat vehicle that was of questionable operational value.

Both the development and fielding of the Sheridan provided many useful lessons learned. The Army staff began pressing the US Army, Vietnam to accept the Sheridan as early as 1966, despite the lack of main gun ammunition. The vehicle was finally fielded in 1969, without its anti-tank missile system.

Different approaches were used by the two units in Vietnam to transition to the new weapon. The 11th Armored Cavalry Regiment elected to stand down units for seven uninterrupted days for transition training. The 3d Squadron, 4th Cavalry decided not to stand down during the transition. Despite the temporary loss of combat power, the stand down approach proved to be highly effective.[7]

As the vehicle began its combat role, it suffered numerous problems. Many of the troops in Vietnam assigned to M551 units

considered the vehicle extremely hazardous. Ammunition fires, rounds that went off prematurely, and numerous maintenance problems gave the vehicle a poor reputation. Troops rode on top of the vehicle rather than inside because of the danger of mines and ammunition fires. Although the PM and other program personnel visited Vietnam to try to stay abreast of the problems, the vehicle continued to have problems. In 1970, the commander of the 11th Armored Cavalry Regiment wrote the following to the Commanding General, US Army Vietnam:

> Lack of Appreciation for the combat environment: When the Sheridan performs a given mission in an outstanding manner at Aberdeen Proving Ground, this does not mean that it will even meet minimal standards in the jungles of Vietnam. ...As CINCUSARPAC stated in his farewell visit to the Regiment on 21 September, the Sheridan was designed to swim, to be airborne, and to achieve a first round hit at great range against enemy armor, but is used for none of these purposes in Vietnam.
>
> Overly-defensive attitude: WECOM and the project managers are understandably concerned about the failure of the Sheridan to live up to expectations. Instead of admitting that the Sheridan needs improvements to make it an effective combat vehicle in jungle operations, the tendency is for CONUS managers to blame shortcomings on poor quality of maintenance in the field, the failure to follow instructions in the TM's that apply to range rather than combat firing, and to make the vehicle do what it is not designed to do.[8]

Perhaps the Sheridan was doomed from the beginning of its development, since its engineers expected to solve problems that were on the outer fringes of the state of the art. Its fielding in an environment for which it was not intended, and one where the receiving command actively campaigned against its issue, will hopefully remain unique in Army fielding history. In any case, the problems and their

impact were part of the reason the Army decided to institute the "hand-off" concept, which was first used on the M60A2 tank.

M60A2 Tank

The old reliable M60A1 tank was to be modified to fire the 152mm Shillelagh as part of the new tank concept. The plan was to mount the new weapon system on the M60 hull with a modified turret gun stabilization and fire control system. All M60s would become 152mm tanks to provide an interim Shillelagh capability until the MBT-70 was fielded. But, as the Armed Forces Journal said:

> Between the idea and delivery, however, something went wrong with the M60A1E2's gun stab and fire control systems which Chrysler is still trying to fix. The problem became a major scandal in congressional hearings and in October '68 the FY 70 buy was cancelled. Initial deliveries began in April 68, were completed in December of that year and consisted of 243 turrets to be retrofitted to existing M60A1 hulls and 300 complete M60A1E2 tanks.[9]

The Army suspended the program and began a major redesign and rework program, followed by a series of engineering and service tests. The results were a new set of deficiencies with some improvement in the mean miles between failure from the previous 30 to about 100. A controversial decision in October 1974 approved the tank for production, despite the user's (CONARC) assessment that the tank was "not battleworthy," and the CDC position that the program should be terminated.[10] Production deliveries began in 1974, and 54 tanks were subjected to an operational test at Fort Hood, Texas. Numerous vehicle and supportability deficiencies resulted. The Army Systems Acquisition Review Council (ASARC) decided to permit fielding of the vehicle, but directed the PM to accomplish a refurbishment program, and provide a complete support package upon fielding in Europe. The unit at Fort Hood retained the test tanks to become the

first unit equipped with the M60A2, but the real fielding was to begin in Europe in 1976.

DARCOM used the M60A2 to implement a new "hand-off" procedure that provided a "warranty" and "total commitment to the user" and his needs at fielding. At a DARCOM conference in May 1976, the Deputy Commanding General of DARCOM reported that "...the concept has proven its worth. The results have been tremendously gratifying and have confirmed that the Project Handoff is the path we must pursue."[11]

But there are always different perspectives on what constitutes success. The commander of that first M60A2 unit in Europe had this to say about the "hand-off":

> The Hand-off of the M60A2 had some good points and bad points. The supply system in-country was virtually nonexistent in the beginning. We used up our "push" packages before we returned from the transition training. We also had shortages in BII, and just about no test equipment was issued with the tanks. The fire control had a very high failure rate and there were few replacement components. USAREUR had to set up a rebuild capability in country to get us well. Our readiness rating suffered, but would have been much worse without the intense management from above since we were the hottest thing in Europe.[12]

An explanation for some of the problems is contained in a 1976 Lesson Learned After Action report from DA, DCSLOG:

> Apparently part of the provisioning package for the IOC battalion was lost in the depot and insufficient parts were available at the unit's home base upon return from transition training at Vilseck. It is estimated that 40% of the M60A2 tank fleet in that unit would have been down if it had not been for the extraordinary efforts of the Project Manager.[13]

The same report discussed problems that occurred with the turret and scavenging systems, and shortages of trained turret mechanics.

Identical problems had occurred years earlier (and were still occuring) with the M551 system. The report's overall assessment included:

a. The DA-directed requirement that tanks be refurbished and a complete support package be prepositioned prior to deployment was not accomplished.

b. There was a lack of formal agreement on support responsibilities and inadequate planning by USAREUR.

c. Deficiencies that had been discovered in prior testing had not been corrected on fielded vehicles.

d. Inadequate quantities of repair parts were available, and the experience factors gained during the operational test were not properly used to determine items and quantities.

e. USAREUR would not permit requisitioning parts in excess of original authorizations (i.e., off-line parts control).

The M60A2 fielding experience also provided a potential lesson learned about over-reliance on contractor support. Both at Fort Hood and in Europe, contractor personnel played a major role in repairing components, managing component replacement actions, and accomplishing much of the critical maintenance. When these personnel finally departed, there was major impact on the unit. Also, during the Fort Hood test and the transition firing activities, parts were replaced with little or no accountability with regard to "demand data." Valuable parts experience was lost. (Demand data is the "heart and soul" of the parts supply system; thus readiness was undoubtedly affected for many months to come.)

It is perhaps ironic that as the M60A3 is being fielded, the M60A2 seems headed for the same fate as the M551, with even fewer years in the inventory. The Army can be thankful there are only 540 in the inventory.

Chaparral/Vulcan

The Army deployed the Chaparral/Vulcan air defense system in 1969-1970 to meet another "urgent" requirement in Europe. The system was deployed without its Forward Area Alerting Radar System (FAAR), which had suffered major technical difficulties, resulting in production termination in July 1969. The system offered limited capability to begin with, but without the radar the system achieved only a marginal improvement in capability.[14] It was not until 1978 that the FAAR radar was fully deployed with the system.[15] By that time, numerous reliability improvements had been applied to the system, but even to this day the system has a poor reputation with both field units and the logisticians who support it.

The system is mentioned because it can again provide an important lesson learned about the value of properly preparing the field units for the arrival of a new system. (The lesson also applied to the M551 experience.) The specific design of the system was in response to a series of threat analysis and requirement studies in the air defense area. The system was designed as a good weather, daytime-only system, and although there were unexpected reliability and maintainability problems, its limited capability was part of the intended design. Field units apparently expected a system that could do much more, but were not properly prepared by the developer for the real capabilities of the system. An important part of the job at fielding for the PM and TSM is to prepare

the user for the new system by making sure the user knows exactly what the system can and cannot do.

Field Artillery Digital Automatic Computer (FADAC)

The fielding of the FADAC in Vietnam was another example of failure to prepare the user and insure that he understood what the piece of equipment could do and how to use it. Many artillery commanders who lacked experience with computers would not use FADAC because they totally lacked confidence in the "machine" that would determine where the bullets would go.

The problems of these early systems should not be oversimplified by saying that the Army made a poor decision in deploying them. Each system provided a new and improved capability that was temporarily or partially negated by problems that existed at fielding. The technical problems and logistical support difficulties would unfortunately become serious problems for the user, whose situation was not adequately considered by the developer in these earlier years. With the introduction of Project Hand-Off and the progress of the ILS program from lip service to at least partial reality, fieldings were expected to be better for the user. Fortunately, the marriage of the developer with the trainer/user in the development state was to become a practical reality.

The next section will discuss the lessons learned from the fieldings of the more recent systems.

III. LESSONS LEARNED: SYSTEMS FIELDED IN 1979

The systems fielded in 1979 that were used to formulate lessons learned included:

Tactical Fire Direction System (TACFIRE)

M-198 155mm Towed Howitzer

M-60A3 Tank

Black Hawk Helicopter, UH-60A

Improved TOW Vehicle, M-901

TSQ-73 Missile Minder

AH-1S Cobra Helicopter (fielded in 1977-78)

Detailed descriptions of these systems are in Annex B.

Rather than discuss lessons learned for each system, it will be more beneficial to categorize the lessons learned into functional areas. Some lessons learned are based on the experience of several systems, while others are based on the experience of a single system. The categories are as follows:

Selected ILS Activities

New Materiel Release Requirement

Operational Testing

TRADOC System Managers

Impact of Fielding on the Command/Unit

Contractor Maintenance Support

The primary guide used by program offices during the fielding of these systems was DARCOM Supplement 1 to AR 700-127. The supplement also contains a format for the Materiel Fielding Plan. A new regulation, DARCOM Reg 700-15, was recently published to replace the supplement. Although a significant improvement, the new regulation

could be further improved by incorporating changes derived from the lessons learned discussed in this section.

Selected Integrated Logistics Support Activities

ILS has increased in importance in recent years and it is now clear that logistics matters are too closely integrated with personnel, training, and the operational concept to be left solely to the logisticians. Inadequate logistics planning is often the cause of program delays and cost growth and has the potential to cause more problems at fielding than any other activity.

Lead time for ILS activities has grown tremendously in recent years. Provisioning, or the procuring of repair parts, is now about a 2-year activity. The assignment of a National Stock Number (NSN) may require a year or more. Technical manuals have become so complex to develop that virtually no new system can be fielded with final (non-draft) versions of manuals. Facilities or construction requirements need to be provided to the gaining command at least 5 years in advance of fielding. The issue of "who pays" for initial support items (repair parts, tools, test equipment, etc.), be it DARCOM or the receiving major command, has become so critical that it was recently the subject of an "8-Star" letter to the Army Chief of Staff, sent from the Commanders of both USAREUR and FORSCOM.[16]

Receiving commands are becoming so concerned about system logistics and "supportability" that they have even recommended a delayed IOC until "validation of the ILS package." A message from USAREUR to the Deputy Commander of DARCOM on the fielding of the M60A3 made these points:

> We want to insure the operational readiness of our units is not degraded....Information available indicates that problems remain in the ILS package, specifically, inadequate TMs, insufficient special tools and test equipment, a shortage of repair parts...and incomplete programs to establish a depot maintenance capability in USAREUR....
> These deficiencies indicate that the M60A3 could not be properly supported if fielding commenced on the programmed IOC date....We have no alternative but to recommend strongly delaying the IOC battalion deployment by a minimum of 90 days.[17]

The deficiencies of the M60A3 ILS package were found to be typical of the recently fielded systems.

Provisioning

Availability of the proper range and quantity of repair parts at fielding is one of the most complex of all ILS requirements. Planning must account for not only system-peculiar parts, but also non-peculiar items, and those managed by other services and agencies such as the Defense Logistics Agency. Quite often, intensive management will be given to the system-peculiar parts while neglecting the "common" items, which often become a problem at fielding.

It is essential that the program office set up a tracking and audit trail system for all provisioning actions. From identification, procurement, cataloging, and NSN assignment to stockage in the unit and depot, intensive management is required to ensure proper availability at fielding. Another critical event from the user point of view is the formulation of the SLAC deck, which lists the items for initial stockage by the units. Because of the cost impact of initial provisioning on the gaining unit, the formulation of minimum essential SLAC items has become an area of great importance. The

listing should be carefully studied by both the program office and the gaining unit prior to actual procurement and stockage of parts.

Various approaches to stockage of repair parts that utilize contractor management for an initial period are being tested. Contracts require packing of kits that contain not only contractor-supplied items, but other parts that are provided to the contractor for packing and shipping to the field unit. In another approach, the NICP is provided requisitions and instruction for direct shipment to a designated unit. These new approaches may provide the basis for major changes in initial stockage procedures.

Whether initial stockage is accomplished by pull, call forward or some form of package shipment, the burden of ensuring that the initial units are properly stocked should be on the developer, not on the field unit. It also seems logical that DARCOM should fund for the initial support items, at least for the IOC unit. This question, however, is still under debate by DA, DARCOM and the major commands.

Technical Manuals

Within the past three to four years, revolutionary changes have occurred in the format and content of Technical Manuals. To cope with more complex systems and the intelligence level of the soldier, profusely illustrated manuals with more detailed explanations of all required actions have been developed. The concept of Integrated Technical Documentation and Training (ITDT) is being replaced by Skill Performance Aids (SPAs). Concepts such as front end analysis and reliability controlled maintenance (RCM) are part of the new manuals, and the previously

complex equipment serviceability criteria (ESC) system has been replaced by a listing of maintenance checks in the operator manual, known as Preventative Maintenance Checks and Services (PMCS).

All of these feacures greatly improve the readability of the manual for the soldier, but they also result in a manual development process that is complicated and lengthy. With the numerous required reviews, tear-down checks, verifications and validations it is unlikely that a system will be fielded with a final version manual. An additional 3-4 months can be added for printing and "pinpoint" distribution. Recent experience has shown that there are advantages to fielding with a draft version of the manuals, thus allowing for later changes from testing and validation exercises. The draft TMs can be printed and distributed directly to the field by the program office (in some cases, the equipment contractor prints the manuals). The SPA procedures permit fielding with a "final draft" manual, allowing 12 months to "...purify and update before publishing as DA authenticated manuals."[18]

The recently fielded systems demonstrated the importance and benefits of soldier validation of the draft manuals at several stages during the development process. But the acid test of manual development is the status of the manuals at fielding time, and the reaction of the first unit equipped. The Materiel Fielding Team should insure that manuals are issued for special tools/test equipment, transportability, and system ancillary items. Also, the manuals should contain up-to-date listings of basic issue items (BII), additional authorization list (AAL), and necessary expendables, with NSNs (not just part numbers).

If any system modifications that are not reflected in the manuals have been made, these changes should be pointed out to the unit along with any part or NSN errors. Strict control of any manual changes at the time of fielding is another essential action. IOC units have found themselves with so many different copies/editions of manuals that problems with operation and maintenance have resulted.

BII; Special Tools; Test, Measurement, Diagnostic Equipment (TMDE)

As a new system proceeds through development and to the point where actual hardware appears, the system exists and functions in a mostly "sterile" environment that includes labs, engineering tests and proving ground type tests under controlled conditions with "white coat" GIs. It is likely that the system can function adequately in such environments with only limited use of any BII, special tools or test equipment. The first operational test or use by "real" soldiers will reveal shortcomings in the development of these items, and every such use thereafter will result in the need for more changes. A primary ILS goal should be to minimize the need for these items because of the major burden they place on the supply system and crew upkeep requirements.

Development decisions on the Makeup of BII, special tools and TMDE should be based, first, on a careful study of the functional and maintenance needs of the system, and second, on accurate analysis of existing and proposed common tools and test and diagnostic items. In some cases, erroneous assumptions are made about the availability of items that may be important to the operation and maintenance of the new system. An area often overlooked is expendable supply items. Not only should the PM accurately determine expendables necessary for

use with the system, he should also insure availability of these items at fielding time.

One of the PM's most important responsibilities, from the point of view of the fielded unit, is to plan and program the funds for system support items, and insure their availability when the equipment is fielded. New equipment should arrive at the unit with complete BII, and a complete issue of special tools and TMDE. The PM and gaining major command should also agree on what additional special kits, tools, ancillary items, etc., will be provided, and who pays for them.

For an appreciation of the quantities of these items fielded with the most recent systems, Figure 1 reveals that the crews/sections have a major responsibility in keeping up with their BII, special tools/test items. TMs have also been included for comparison.

Figure 1: System Support Items

SYSTEM	TMs	ITEMS of BII	Number of Special Tools & Test Items (Org,DS/GS)
TACFIRE	54	24	7 kits, spt. vehicle w/2 men 2 GS Test Sets Module Test Set
M198 Howitzer	9	45	12
BLACK HAWK Helicopter	40	-	64
M60A3 TANK	67	77	192
Improved TOW Vehicle	50	43	25
AH-1S Helicopter	115	-	35, plus 11 special kits

Source: Materiel Fielding Plan for each system

Closely related to BII, special tools and test equipment are the other ancillary items required for operation and maintenance of the system. While new or revised TO&Es may include ancillary items required for the system, it is unusual to find all items available upon fielding. Often, commands are required to shuffle assets internally to make the required items available for a newly fielded system. This is a painful and complex process for field units, where property accountability is a difficult task even without such equipment transfers.

In addition to complications caused by support items, new systems are fielded with ancillary items so complex that a separate PM manages the item. The Black Hawk helicopter contains a doppler navigation system managed by the PM, Navigation Control Systems. The ITV is being fielded with a Night Sight, AN/TAS-4 which requires several major pieces of test and maintenance equipment. The night sight is managed by a different PM,[19] which means that three separate PMs are involved with the fielding of the ITV system. A somewhat exasperated member of a major command attempting to manage such fieldings stated:

> The point to be made here is that in order to successfully field a fully operational, sustainable ITV, we must deal not only with PM ITV for the vehicle itself, but also with PM TOW/DRAGON, CERCOM, ERADCOM, and the Night Vision Lab for the night sight, and with TARCOM for the trucks to haul test equipment, and TSARCOM for necessary generators. The notion that a single DARCOM PM can tie everything needed for fielding together is false.[20]

Facilities Planning

Although "facilities" is one of the original elements of ILS which has been recognized in DoD since the early 1970s, it tends to receive scant attention unless the system has major construction requirements. Recently, the issue of construction requirements has become even more critical, as existing facilities are already used to full capacity, and any funds for expansion are extremely difficult to obtain. The situation in USAREUR perhaps speaks for most of the major commands:

> Utilization of USAREUR facilities currently approaches 100% and many of the existing facilities (for troop and family housing, admin, maintenance, ammo, POL, etc.) are less than adequate to support current requirements. The introduction of new equipment often adds requirements for new facilities, and /it is/ not always immediately apparent that facilities will be required for a particular system.[21]

The special management of construction funds requires that facilities be planned and programmed much earlier than other fund categories. Additional information and justification are needed for budget input, both at the major command level and at DA level. Some facilities may require modification, repair, refurbishment, or additional power handling capability before new equipment arrives. Without a careful on-site survey by the developer and the receiving command, deficiencies will exist at fielding time.

It has become clear that the facilities area is one that needs greatly increased attention by the developer, to include planning and budget programming that begins more than five years before fielding.

Distribution Planning

The distribution plan for a new system is an important aspect of the materiel fielding process. After selection of the IOC unit, new equipment distribution is prioritized and scheduled, based on availability of delivered systems from the contractor/production facility.

Some confusion has entered the planning process as DARCOM and DA occasionally accomplish parallel plans that do not always agree. DA uses the Basis of Issue Plan (BIOP) and the DA Master Priority List (DAMPL) to establish a distribution schedule, while in DARCOM the "item manager" or PM representative makes his own plan which may follow a different priority system. This confusion often results in a series of changes to the distribution plan that will have a major impact on gaining commands/units. The problem was pointed out in the 1978 AH-1S Report on Deployment to USAREUR and CONUS:

> The distribution plan for the AH-1S has been in a constant state of change since CY 1977. The original plan proposed distribution to certain installations in blocks of four aircraft....The plan was then revised by DA to reflect aircraft issues in blocks of nine or more. At a later date, the schedule was revised by DA to implement certain ARCSA III provisions. Still another DA revision reflected new DAMPL considerations.

Similar problems are caused by changing the IOC unit. Since final operational tests are often conducted by the IOC unit, changing the IOC unit can have a major impact on an installation/unit. Although the needs of the Army necessarily change over the long development cycles, an important objective for both the PM and the DA staff should be careful selection of the IOC unit, followed by strong resistance to any change as IOC approaches. Several of the systems studied changed IOC units after the initial selection.

Operational Testing

After the production milestone, a major system will normally undergo an initial production test and some type of operational test, such as a follow-on evaluation or force development test. If DT/OT II reveals significant deficiencies, a DT/OT IIa or III will normally be required before the production decision.[22]

Some type of post-production operational testing is necessary to demonstrate Reliability, Availability, Maintainability (RAM) of the production equipment, and determine the suitability of logistics, training, and mission performance in an operational environment. Figure 2 shows the type post-production test conducted by some of the recently fielded systems.

Figure 2: Operational Tests

System	IOC	Type Test
M 198	April '79	Follow-On Evaluation (FOE)
BLACK HAWK	Nov '79	IOC-Force Development Test Experimentation (FDTE)
ITV	Jan '80	FOE
M60A3	June '79	IOC-FDTE
TACFIRE	April '79	FOE

Except for the TACFIRE FOE, each test preceded IOC by a short period of time. The tests for M 198, Black Hawk and TACFIRE were all conducted by the IOC unit, and all were fielded in CONUS. The other systems were fielded in Europe, where it is apparently not feasible to conduct formal operational tests. One important conclusion can be drawn from these tests: Fieldings are much smoother when the IOC unit is also the final operational test unit. When

this condition does not exist, a major burden is placed on the fielding team and the major unit involved.

Planning and preparation for the operational test should be a high priority item for the PM, and his counterpart, the TSM. Recent fieldings show there are several key areas that require special attention.

The Test Plan

The test plan should be a joint effort by the PM, TSM and OTEA, with careful consideration to the key factors of test objectives, evaluation criteria, mission profiles, and resources required for the test. The test location is also very important and should be coordinated and approved at least 18 months before the test. Since the test will have a major impact on the installation and command involved, the installation commander should concur in the decision to conduct the test. Late changes in test locations can have a severe impact on all parties. The program office should have representatives present throughout the test to assist with unforeseen problems and observe the performance of the equipment. Also, PM/TSM representatives must be alert for system-related deficiencies that might affect the orderly accomplishment of the test. As system failures begin to occur, the PM will be reminded of the critical need to insure that RAM scoring parameters are established before the test (and agreed on by the TSM and OTEA), and scoring conferences held during and after the test.

Maintenance/Training Support Packages

Planning for both the operational and development tests is accomplished by means of the Test Working Integration Group (TWIG). The TWIGs present a series of forums where plans and potential problems can be discussed by all the principals involved in the tests. While there are a large number of items to plan and coordinate, one that deserves special attention is the support packages for the test. The program office must design a "package" of spare parts, tools, test items, expendables, BII, TMs and other items needed during the conduct of the test. Any shortages affect not only the validity of the test but also the confidence the test troops have in the new equipment. An incomplete or late support package is grounds for OTEA to delay start of the test.

On recent tests the training support package has become as much a problem as the maintenance package. While operators usually receive the necessary training, maintenance personnel and test cadre have been neglected in the test preparation.

Review of EPRs, OTIRs and SPRs

As occurred with the M60A2, systems continue to be fielded with known deficiencies that were discovered during testing but were not corrected. Nothing can be more troublesome to members of the receiving unit who happen to be aware of them. A specific plan for review and action on test deficiency reports is an important aspect of readying the system for fielding.

Equipment Performance Reports (EPR) result from development testing, while Operational Test Incident Reports (OTIR) and System Performance Reports (SPR) result from operational tests. An audit

and tracking system should be established to insure that each report is closed out with some form of action. This system should include review by the TSM for the non-routine reports. Those reports that result in system changes, engineering change proposals (ECP), or technical manual changes should be carefully annotated to reflect that such action was taken. All other reports should reflect that some final action was taken, or that no action was necessary.

Not only do these test incident reports receive inadequate follow-up action, but overall test results that specify system deficiencies often do not result in system modifications. In each of the earlier operational tests (OT I, OT II) the findings normally specify that deficiencies will be corrected prior to the next test. With the conduct of the final operational test, there is virtually no means for insuring that corrective action has been taken. Once again, the party who suffers is the user, as he starts the painful process of "maturing" the system in the field.

While all of the recently fielded systems experienced deficiencies during their final operational tests, no one expected any of the complex new systems to complete the test without problems. In some cases, the problems went beyond deficiencies with the new system. As an example of the potential difficulties, problems experienced during the M60A3 IOC-FDTE are worthy of review. The OTEA Independent Evaluation Report of June 1979 listed the following problems and deficiencies:

1. Test location changed from Fort Carson to Fort Polk just 7 months before the test.

2. The test tanks arrived late, and tank gunnery problems forced the test directorate to eliminate all tactical exercises.

3. After completion of the test, ARRCOM discovered that all M35E1 periscopes were defective. Later the M10 ballistic device was found to be defective. The validity of all test hit data was therefore questionable.

4. The maintenance support package was incomplete, and test time restrictions prevented a complete assessment of logistic support under field conditions. No evaluation was made of mechanic training or overall logistic support factors.

The Report also stated that the M60A3 tank without the tank thermal sight (TTS) did not provide a significant increase over the M60A1 (RISE passive) in ability to accomplish the mission. This finding is of particular importance because the initial battalions of M60A3s already fielded in Europe do not have the TTS. It will undoubtedly be disturbing to these battalions to learn that the Army plans (under the Foreign Military Sales Program) to sell Egypt 244 M60A3 tanks beginning in December 1980.[23] These tanks will have the thermal sights, resulting in a foreign army achieving a capability before a number of high priority US Army units.

New Materiel Release Procedure

DARCOM Regulation 700-34 requires detailed certification of system suitability prior to release to the field (see introduction). While the procedure serves a necessary and worthwhile purpose, there are several problems with the procedure. First, there are inadequate checks on the requirements of the regulation to insure that systems approaching fielding are accomplishing release requirements. For example, the TACFIRE system did not receive release certification until after IOC and fielding. The Black Hawk system was fielded with no release whatsoever, and even today has no release.

Major systems routinely receive "conditional" releases because of shortcomings in such areas as logistical support and incomplete test results. The M198 howitzer, ITV, M60A3, TACFIRE and AH-1S all received conditional releases. Fielding with a conditional release requires a statement of an "urgent" requirement for the new equipment. While it is a rather simple matter to provide a written justification for an urgent requirement, the real urgency in the field is sometimes difficult to understand. For example, the M551 was fielded under stated conditional and urgent conditions, but even a congressional committee failed to see the urgency. The fielding of the M198 howitzer was considered urgent, despite the fact that only a single battalion was equipped, followed by an 18-month gap until other units were equipped.

The regulation requires that the user formally agree to all system deficiencies that bring about the conditional release. There is no documentation to reflect that the user agreed to the conditional release of either the M60A3 tank or the ITV. Finally, the intent

of the regulation is to achieve a materiel release prior to IOC and fielding, but this is not specified anywhere in the regulation, and has led to confusion as systems approach IOC.

There is no doubt that the materiel release procedure is not only desirable but also essential to insure that only safe, supportable, completely tested equipment reaches the field. The number of major systems fielded with conditional releases, however, seem to indicate that releasing systems to the field with many deficiencies has become institutionalized. It is even more unfortunate that these deficiencies usually have major impact on the user.

TRADOC System Managers

The Army studies that led to the establishment of the TSM concept included:

Total Tank System Study (T^2S^2)

Anti Armor System Study (A^2S^2)

Tank Forces Management Group (TFMG) Review

One of the important findings of these studies was that the Army's combat capability and operational effectiveness were drastically reduced by lack of planning for the personnel, training, and logistics aspects of new systems. The Army realized that its weapons acquisition programs had been hardware oriented, with little emphasis on critical supportability needs after fielding.

The Army's TFMG Review,[24] conducted in the 1976-77 time frame, could be used to point out many of the "total system needs" of all new systems, not just tank systems. It recommended the following:

- Separate career field or MOS for new systems
- System qualified and trained NCOs
- A dedicated weapon management office at selected levels
- Entry level training for officers in the new system
- Revised curricula at NCO schools to teach system technical skills
- Revised maintenance/log training to accommodate the new item
- Spare parts stockage based on wartime need, rather than training demand/usage
- An integrated system for resupply/rearm of the new system

Implementing these recommendations just for <u>new tank</u> systems would be challenging enough (and is being attempted), but to expect to do the same for <u>every new system</u> would tend to overload the Army's existing training and personnel system. And yet these tasks are representative of what each TSM strives to accomplish for his system.

Although the concept has been in effect for only a short time, it is possible to view some experiences and lessons learned from the TSMs of the recently fielded systems. Detailed letters were received in answer to the author's questions to TSMs about the fielding of their systems.[25] Their verbatim comments in selected areas provide valuable insights.

Concerning Influence on System Design, System Changes

> The user had very little influence on the initial design since three different corporations provided three different designs, each with unique configurations designed to meet the ROC...(regarding system changes/improvements) that did not entail coordination with more than one PM, the task was fairly easy. If two or more PMs were involved, it became very difficult....about the only way to get realistic schedule and cost impact was to request DARCOM convene a meeting between the PMs involved and the TSM.
>
> My office developed the philosophy of holding the requirement still and not changing it and let the developer do his job. As a result, there have been only two changes since 1971 and both were to eliminate requirements. I will admit that the production version represents old technology (in today's world) but we can improve it, and we are able to field a system that we can identify, train against, issue pubs, and logistically support.

Concerning Funding Problems

> The recurring problem is to rejustify funding on an annual basis. Delays in development, changing priorities and budget considerations beyond the control of the PM and even the Army cause havoc for lower priority work. In particular, training devices and ILS elements are vulnerable because of their perceived lower priority.
>
> Budget for ASL/PLL was not adequately planned for by TRADOC, FORSCOM and USAREUR....With all our expertise in costing we still have trouble in estimating the cost of unit training. The need for a cost of training and effectiveness analysis (CTEA) has been demonstrated time and time again.

Concerning Transition Training for the New Equipment

All transition training package developers are forced by real constraints of time and money to make certain assumptions regarding the state of training of the unit to transition. This "training baseline" represents assumed skills needed to complete transition training but that will not be taught during NET. The training developer is inclined to make an imprecise and excessively broad assumption on the unit's training baseline. Unit commanders have ignored the assumed baseline warning due to the press of other problems, even after we have provided a defined baseline and the opportunity to conduct remedial training, if required.

Concerning IOC and Actual Fielding

IOC is a myth. It is when the unit is fully equipped, personnel have been trained in operation and maintenance and have the necessary tools, spare parts and pubs to maintain the equipment. Then the unit training can begin. There are others who maintain that IOC does not occur until the unit is trained. If we attend to this philosophy, then in some cases, IOC may never occur. IOC is merely a target date...most IOCs are classified which is patently ridiculous.

Current regulations that mandate a simultaneous fielding of a system, its technical, training and doctrinal documentation and fully developed and tested training devices are not realistic....It can waste vast sums of money through continued revision of support systems to reflect unanticipated but necessary changes in the supported system.

The "players" change more rapidly in USAREUR than in CONUS. Briefings designed to coordinate (fielding requirements) were seldom attended by the same people twice. Hence transient management threatens early achievement of operational readiness at every step in the fielding process.

Concerning Operational Testing

The influence of the mission proponent for the system is considerable. The problem is keeping outside agencies from entering non-significant issues into the test.

We generate critical issues for test, the training package, comment on all coordinated test plans, participate in judging the result, and in briefing the findings to decision makers. We see the operational test as a testing vehicle for training and logistic packages for use in fielding and beyond.

> A continuing problem in the management of testing in the Army is failure to develop and staff test issues early enough so that the test design can be developed and integrated into the test to answer relevant issues....We have difficulty coming to grips with the criteria against which a particular issue is to be evaluated. If the criteria cannot be measured then it is not an evaluation tool. If it cannot be measured, the user, TRADOC cannot force the PM to meet that particular criteria....The single area where TRADOC, DARCOM and OTEA had the most difficulty was establishing acceptable failure definition and scoring criteria to be used as a basis for generating RAM computation.

The TSM regulation (TRADOC Reg 71-12, 15 Sept. '78) specifies that the TSM "...will insure that training personnel, and logistical subsystems are developed which will meet the user requirements...." The subsystem development process is a cooperative activity with the Project Manager and the center/school that has system proponency. Although not specified as a TSM task, the TSM must also develop an operational employment concept for the weapon system.

But the real challenge for the TSMs managing major new systems will be in the areas of manpower and training. Recent Army studies (unpublished) project that it will not be possible to produce the large numbers of skilled soldiers required for all the new systems coming on line. Also, new systems require non-commissioned officers as section/crew chiefs. Where will they come from? If they are taken off other systems and retrained, the problems of phasing in new systems and phasing out old systems become a major management problem well beyond the capability of the TSM.

Training for major new systems presents an even wider range of challenges. The skyrocketing costs of ammunition, fuel, and repair

parts bring about the need for innovative approaches to training. Training devices, simulators, and visual aids for both operators and maintenance personnel should be a high priority effort as the training system is developed.

The Impact of Fielding on the Command/Unit

Major commands are in the process of developing a structured, institutionalized system to manage the fielding of new systems. "Force modernization" offices can now be found at all levels of the Army down to the division. Commands such as USAREUR are moving out aggressively to gain control of the complex fielding process and are beginning to issue their own detailed deployment plans for new items. USAREUR, for example, issued a deployment plan for the Improved TOW Vehicle.[26] (The PM was not on distribution!)

But the major concern of the modernization offices is the budget/funds impact of the new systems.

> By far the greatest challenge in fielding new equipment in USAREUR is the requirement to reconcile the event-oriented Life Cycle Management Model (of DA Pam 11-25) with the calendar-oriented events of the USAREUR PPBS.[27]

In an attempt to assist gaining commands in the fielding requirement and close the "information" gap, the Army has started to publish a compilation of data on all new systems, known as the Army Modernization Information Memorandum, or AMIM.

The Army Modernization Information Memorandum (AMIM)

In October 1979, DA published for the first time a detailed description of new equipment that would be fielded in the next five years. The AMIM provides major commands with planning and resource data on both major and non-major systems over the PPBS cycle.

The AMIM played a major role in bringing to light significant problems in the planning and programming process accomplished by major commands in the area of new equipment. Without detailed information from the materiel developer, the commands were unable to project requirements adequately in such areas as facilities/construction, stock funds for repair parts, and personnel and training

requirements. Now that much of this information is available, some commands are projecting major shortfalls and have even stated that fieldings should be delayed until required resources are available. Another point that has emerged from this exercise is that there is more than one "Bow Wave." Besides procurement dollars, operations and maintenance dollars in the out years have also become critical. The second bow wave is also called the "undertow," since it pulls down readiness posture because of insufficient stockage of repair parts.

While the command is managing these funding problems, it will also be faced with some difficult unit-level problems that require careful planning and coordination with the DARCOM fielding activities.

Transition to New Equipment

Activity at the unit level includes a myriad of tasks in anticipation of the arrival of the new equipment. Some of the most important activities are:

* Turn-in of replaced item
* Unit training for the new item
* Build up and management of repair parts for new items
* Changeover/issue of system support items, such as vehicles, generators, ammunition, communication items

Each of these areas requires careful planning and a dedicated, coordinated effort by the major command, the PM, and of course, the unit involved. Experience with the recently fielded systems points out that no matter how detailed or complete the planning may be, problems will still arise. There is a need for new thinking in the formulation of materiel fielding plans and fielding agreements. These plans are written from the DARCOM point of view in a more or less standard format that often does not take into account peculiarities of the command and unit involved. In most cases there has been

no direct Memorandum of Understanding (MOU) with the unit involved, which leads to considerable misunderstanding and information gaps.

While the intent of the Statement of Quality and Support (SOQAS) process is to achieve "total" user satisfaction and support, in some cases the user or IOC unit has been far from satisfied. The commander of the M60A3 IOC battalion in Europe had these comments:

> The most significant problem /during fielding/ was the lack of official information provided to the battalion during the entire period.... Lack of official information created changes and turmoil based on unofficial rumors from staff section above the battalion.[28]

The same commander also commented that his first notice (official or unofficial) about the transition to the new tank was received in November 1978 for the fielding that was to begin in May 1979. He also made a detailed record of problem areas during fielding. Ironically, many of the same problems had occurred in the same battalion three years before when the M60A2 was fielded:

* Criteria for turn-in of old tanks changed almost monthly.
* Difficulties were experienced with ammunition requirements.
* Problems were experienced with critical MOSs for the new tank.
* The new tanks exhibited poor quality control during manufacturing requiring "...2-3 days concerted effort for each tank crew to correct."[29]
* Numerous problems with the fire control items (manufactured by the same contractor as the M60A2 fire control).

The command will also have to contend with a readiness impact as the old equipment is prepared for turn-in and the new equipment is not completely issued or operational. One command asked (and received DA permission) to retain the replaced item for a 90-day period after IOC so that either would be available in the event of a contingency requirement.

There are other examples where complete planning with continuously updated MOUs between the PM and the unit failed to prevent major problems that delayed achievement of a full operational capability. The system involved employed a critical data link that proved to be incompatible with its critical subscribers. Additionally, a requirement to employ the system out of bunkers proved to be very difficult to accomplish in the "real world." In both cases, the potential problem was known before fielding but controversy over responsibilities, particularly funding, prevented resolution before the equipment was put in the field.

Contractor Maintenance Support

As new equipment has become more complex, the system contractor must often provide on-site assistance for a temporary period after fielding. After initial problems are solved and Army-trained maintenance personnel become proficient, the contractor personnel normally depart. In some cases, a contractor repair capability for selected components has also been necessary.

While these procedures can save money and reduce the burden of maintenance training immensely, the Army has attempted to avoid the contractor approach as a general principle, despite the fact that directives (such as DoDD 4151.1) encourage use of contractors. It is true that the results of most of the temporary arrangements have been satisfactory, with the exception of the "withdrawal" problem discussed in the M60A2 section.

Army electronic and missile systems are a special case in point. Traditionally, these systems have relied more heavily on contractor support than other systems. In some cases, contractor maintenance is a full life cycle requirement, rather than a temporary phenomenon. There appears to be a trend toward even more contractor dependence with new systems to be fielded in the next few years.

The TACFIRE system, for example, was fielded with a contractor-dependent maintenance/repair concept. After more than a year in the field, the system is still experiencing problems with the response time and overall management of the concept. The TACFIRE system was intended to make the transition to "normal supply support" procedures on 1 March 1980, but did not succeed.

Current plans for the PATRIOT missile system call for a method of built-in tests for fault isolation with little or no test equipment such as is used with most other missile and electronic systems. Faulty battery-level replaceable units will be transported directly to the contractor for repair. The plans for the soon-to-be fielded Stinger missile system also contemplate a roving contact team for maintenance above organization level, with no other military capability between organizational and depot level.

Missile/electronic systems are not the only systems that will be relying on contractor support. The Black Hawk system is using the contractor for both wholesale supply support and depot maintenance through March 1982. (Separate contractors are involved for the air frame and engine.) Although not all National Stock Numbers (NSNs) have been assigned, the system utilizes standard requisitions to the contractor, which will make conversion after March 1982 much easier. Although this system has been operation for only a few months, it is operating effectively so far.

These contractor-dependent systems raise questions in addition to the obvious ones about operation and support under a conflict situation.[30] How will the prioritizing, collection, and transportation of faulty components be managed for the yet-to-be-fielded systems? Also, determining criteria for contractor float and DX items, funding, and location of repair facilities will require careful planning.

Another related issue involves the often-heard claim that Army equipment is becoming overly complex and difficult to operate. The Army is attempting to dispel this idea. In its FY 81 statement to

Congress on RDTE and Procurement requirements, the Army addressed the issue this way:

> The question, as usually put, is where is the country to get the Army of PHDs that will be required to operate all this sophisticated, complicated hardware? The answer is that these systems will not require engineers to operate or maintain them in the field. On the contrary, most of the weapons are easier - sometimes radically easier - to operate than systems they will replace....The new systems have been designed with the troops in mind - their sophistication is internal. (emphasis added)

While simplicity of operation may be a fact, the potential problem area caused by the "internal sophistication" is complex maintenance and repair. Soldiers may be capable enough to operate the equipment, but repair and maintenance may present a challenge to the Army that can be solved only by lengthy maintenance training schools and use of on-site civilian contractors for extended periods. While the Army is taking both approaches, the trend is for even greater contractor dependency as contracts contain more and more logistic and supportability requirements.

Of all the recently fielded systems studied, only one (M198 Howitzer) did not rely on contractor technical assistance and component repair for at least a temporary period.

Despite these issues and potential problems, there are good reasons for contractor support. The major maintenance training resources required for the fielding of a new system can be greatly reduced by reverting to contractor support. Also, the American GI is just not capable of learning the complicated maintenance and repair of many systems without an inordinately long training period. The advantages of contractor support must be balanced against the disadvantages of dependency on a contractor who may not be around in a conflict.

Summary of Major Lessons Learned

Integrated Logistics Support

- Provisioning is a long lead time activity that requires careful monitoring.
- Technical manual development requires frequent soldier validations.
- BII, special tools, and TMDE add considerable burden to the weapon system and supply system.
- The construction, repair or refurbishment of facilities required for the fielding of new weapon systems has received inadequate developer management attention.

Operational Testing

- The test plan should be a carefully coordinated effort by the TSM, PM and OTEA or test agency.
- Maintenance and training support packages need additional emphasis to insure complete availability at test start.
- A tracking and audit system is required for all EPRs, OTIRs and SPRs.

New Materiel Release

- Not all release requirements are being accomplished.
- Excessive conditional releases have led to institutionalized release of new systems with numerous deficiencies.

TRADOC System Managers

- TSMs face major challenges in developing and fielding adequate and on-time personnel and training systems.

Impact of Fielding on the Command/Unit

- The major (receiving) command must reconcile the Life Cycle Management System with the PPBS for each new system.
- The receiving command must develop a fielding/transition plan in coordination with the developer's MFP.

Contractor Maintenance Support

- New systems are relying more and more on post-fielding contractor support, often with unsatisfactory results.
- As system maintenance and supportability requirements have increased, the Army has shifted much of the related development tasks to contractors.

IV. CONCLUSIONS AND RECOMMENDATIONS

Documenting Lessons Learned

An important recommendation at the outset concerns the need for documenting and making available lessons learned about the fielding process. This research effort revealed the following:

* Few lessons learned are documented.
* If documented, they are often filed in the originating office, or sent to a functional office with little or no opportunity for use by a future PM.
* Lessons learned presented at PM conferences are seldom retained on file, or shared with the working level at the Project Management Office.

The new DARCOM Regulation 700-15 requires a lessons learned summary "...within three weeks after completion of the DARCOM effort in the gaining command." This requirement, if enforced, will be an excellent first step. An official repository for lessons learned needs to be designated. Those that exist are scattered throughout DARCOM with some concentration in the Offices of Project Management. The Defense Systems Management College should also be considered as a repository.

The practice of submitting DARCOM Form 2410-R has proven totally ineffective as a follow-up check after fielding. The only action taken by the addressee of the form, the Materiel Readiness Support Activity (MRSA) is compilation of a statistical report to Headquarters, DARCOM, which in turn either files the report or compiles a summary report for the command group. There is no evidence that any action has been taken by DARCOM as a result of negative 2410-R answers submitted by an IOC unit.

Establishing an IOC Date

The major problem with IOC dates is that they are set too early in the life cycle and are often based on risky estimates of program time requirements. The benefits of setting a fixed IOC date outweigh the benefits of setting a more flexible date, but the date should be reconfirmed at the production decision milestone. The adverse impacts of accepting many deficiencies if the IOC date is to be met may justify delay. The opportunity for an "official" extension, if necessary, will help all parties planning for the forthcoming IOC.

ILS Activities

The concern (and budget support) for the various ILS areas is beginning to go beyond the lip service stage. The major budget impact and detailed planning necessary for such activities as initial support items and facilities require acquisition managers at all levels to concern themselves with areas previously "left to the logisticians." The central ILS concept that the entire logistic system must plan and prepare for each fielding is proving to be the key factor in achieving a successful fielding. The recent passage of a revised DOD directive on ILS-[2] will further support increased emphasis.

A critical requirement is determining the complete needs of the system in the areas of repair parts, special tools, TMDE, and ancillary items that are essential to system operation and maintenance. This includes the responsibility to insure availability of these items at fielding time. The PM should insure that proper management attention is also given to those items that are the responsibility of item managers and the receiving command.

The trend toward increased contractor responsibility for critical ILS functions should cause some concern. Production contracts often contain requirements for delivery of a support package that can include a complete provisioning effort, technical manuals, trained operator and maintenance personnel, training devices, and system maintenance and repair capability that supplants the Army depot system. While this approach shifts a major burden from the program manager to the contractor, there are at least two potential problems with this approach:

- Program office has reduced visibility and control over critical ILS activities.
- DARCOM managers of the affected ILS areas may be slowly put out of business.

The ability of the contractor to accomplish effectively highly complex ILS activities (that the Army has had difficulty accomplishing in-house) is also an area of concern.

The issue of <u>who pays</u> for the initial support items will continue to be debated. The USAREUR experiment with the fielding of M113A2 and ITV PLL/ASL through carefully managed package shipments proved reasonably successful, but failed to change the existing policy that requires the receiving command to fund the initial support items. It seems clear that as part of SOQAS, DARCOM should manage the setting up and funding of initial support items for at least the first unit equipped or IOC unit. If the philosophy of SOQAS and Hand-Off is to be meaningful, the major burden of conversion and management of the initial PLL/ASL, special tools and test equipment should be carried by DARCOM and the MFT, not the unit. Field units are ill-equipped to manage the complex conversion to a major new piece of equipment.

A final conclusion in the ILS area concerns the need for more active participation by logisticians in the planning and decision reviews during system development. Several key managers at the policy and operating level commented that major logistics deficiencies still exist because logisticians do not actively participate in decisions reviews and planning sessions. Rather than standing by and saying, "Tell me what you want done and I'll do it," the feeling expressed is that the logistician must predict problems and aggressively insert himself into the process.

Operational Testing

A major effort should be made to conduct the final operational test at the IOC unit/installation. The benefits to fielding are numerous, and the unit/command involved will achieve IOC in a much higher state of readiness.

DARCOM's record of availability of required resources to begin an operational test needs to be improved. Both maintenance support packages and training support packages have been deficient in the past. Systems to be tested have arrived late and with hardware deficiencies that affected the test outcome. Test units are not provided adequate manuals, BII, special tools and ancillary items that are an essential part of the total system, reducing troop confidence in the equipment and affecting the validity of the test results.

As logistics and supportability factors of new systems become more complex, the ability of operational tests to evaluate all supportability requirements adequately has diminished. The combination of not enough time and non-availability of key system support items

has resulted in many systems advancing to fielding with a support and maintenance concept that has not been adequately tested in an operational environment. At a minimum, a Follow-On Evaluation should be required after IOC to test, in an operational environment, all major supportability factors. Such an approach is being followed by the Infantry Fighting Vehicle (IFV) program.

New Materiel Release Procedure

The provisions of DARCOM Reg 700-34 are valid and should be complied with by all system managers. Certain aspects of the regulation are not being enforced, while others have brought about a condition of institutionalized acceptance of new systems with excessive deficiencies.

Since most major systems are released under conditional circumstances, there is a need for at least two categories of conditional release. One should specify that certain deficiencies must be corrected before IOC, while the other can remain essentially as currently written. The "user agreement" to the conditional release should include both the system TSM and a representative of the gaining command/unit. It is not possible for the TSM alone to be aware of the full range of impacts that the various system shortcomings will have.

TRADOC System Managers

TSMs are having a favorable impact on the development and fielding of new systems. While the personnel and training problems associated with new systems are far from solved, at least a focal point of responsibility is now part of the acquisition community. Since experience has shown that simultaneous fielding of the new

system with a revised MTOE, all personnel and equipment, and a complement of fully trained personnel with new MOSs is often not possible, a concept of phased fielding of these activities should be developed. The development of the training base with efficient but expensive training devices should also be phased in to prevent wasted expenditures for a new system that might be cancelled or delayed after only a limited production.

TSM responsibilities need to specify the requirement for formal development of an employment concept, particularly for systems that employ advanced technology weapons and systems. Since the PM and most of his personnel have technical backgrounds, it is only natural that they concentrate on technical development problems rather than employment concepts. The TSM should fill this void and systematically develop an employment concept in parallel with the personnel, training and logistics systems.

Impact of Fielding on the Command/Unit

The concept of force modernization offices should be institutionalized, but the issue of proponent staff agency needs more study. The majority of fielding issues are logistics oriented; thus more consideration needs to be given to establishing the office under the DCSLOG rather than DCSOPS.

Efficient fielding requires simultaneous accomplishment of a wide range of activities at all levels of the chain of command. The MFP cannot address (nor was it intended to address) all these activities. Major commands should have their own fielding plan for each system, addressing such issues as turn-in of replaced items, unit training and personnel requirements, and management of support items. The MFA and MOU should clarify responsibilities in

all such areas, and should designate a single PM as the point of contact for the gaining command/unit for those systems with multiple PMs involved.

The MFT needs to insure that new equipment passed off to the unit has been 100% checked for deficiencies, has complete manuals and BII, and is ready to perform its operational mission. The SOQAS period should cover the complete fielding period, not just the transition training period or limited hand-off period.

Contractor Maintenance Support

The use of contractor maintenance and repair should be avoided. Program managers who propose a temporary period of contractor assistance after fielding should be required, at key briefings such as LOGCAPs, DAPRs and ASARCs, to present a plan for transition to Army-only support.

The trend towards shifting more and more of maintenance and repair requirements to contractors should also be reconsidered. The expertise and capability of many contractors to accomplish these requirements adequately over the long term and in a conflict environment is not always evaluated.

Needed: A DA Fielding Policy

With some 50 new major systems to be fielded in the 1980-1985 time frame, the Army needs to develop a policy and a commitment to the fielding process. The DA Force Modernization Office is the obvious management agency for such an effort, with DCSLOG and other staff agencies providing key inputs in their areas of proponency. The current DCSLOG efforts to update the regulation on Integrated Logistics Support could be the means for an expanded effort to cover

other areas related to fielding. The policy should include consideration of the ability of the average soldier to be trained to maintain and operate the sophisticated new equipment.

Another important issue concerns the extended development times which result in new weapons being fielded with " . . technology. One of the major reasons for congressional cancellation of the TACFIRE program was the concern that the Army was fielding a tactical computer system with 15-year old technology. The M60A3 tank is being fielded with fire control technology that is of the same vintage (1970) as its predecessor, the M60A2.

The shortened acquisition cycles for such systems as XM1, IFV and MLRS are encouraging, but the acquisition times for these systems were mandated by Congress rather than planned by the Army. While the mandate shifts some of the acquisition "risk" to Congress, the Army needs to accept the risk and make the commitment itself to shor en acquisition times. This commitment and risk sharing must be carried by all members of the acquisition institution, not just the Army. Perfect information, confirmation of all program objectives, and the concurrence of the normal long list of agencies before a decision is made must become a thing of the past. DARCOM's Deputy Commanding General, LTG Robert Baer, had this to say about the issue of extended acquisition times:

> No materiel system is ever going to be fully mature when it is fielded. No testing program, no matter how extensive and how costly, will ever expose all the problems. Systems grow to maturity only through experience in the hands of troops in the field. We have to say, at some reasonable juncture of proven performance, time and money, that, "we've gone about as far as we can go, get on with fielding.[33]

On the other hand, LTG Baer goes on to say, "I am not, however, advocating that systems be fielded simply because the "schedule" says it's time to field." Clearly, the Army must make the difficult decision for each system on a case-by-case basis.

The final aspect of the fielding policy should provide for the institutionalized commitment to user satisfaction and support at fielding. Not only should the provisions of SOQAS and Hand-Off be strengthened and expanded, but they should become the DA policy rather than a matter of choice by the developer.

V. SUMMARY OF MAJOR RECOMMENDATIONS

1. Lessons learned need to be documented, collected, and made available to program managers.

2. IOC dates should be formally reconfirmed at the production milestone.

3. Development of initial support items requires added emphasis to include evaluation of the trend toward increased contractor management of these activities.

4. The fielding and funding of initial support items for the IOC unit should be managed and paid for by DARCOM.

5. Logisticians need to play a more active role in the acquisition process, particularly DA-level planning sessions and decision reviews.

6. Conditional release (DARCOM Reg 700-34) needs to be revised to define two categories, specifying certain deficiencies that must be corrected before IOC.

7. DARCOM should evaluate the trend towards increased use of contractors for accomplishing ILS tasks, and the increased reliance on contractors after fielding.

8. The final operational test should be conducted by the IOC unit.

9. OTEA emphasis on evaluating system supportability needs to be increased.

10. The TSM should be formally charged with the development of a system deployment concept.

11. Major command force modernization offices need to develop a regulation and procedure for materiel fieldings, to include guidance on turn-in of replaced items, unit transition training, and management of new support items.

12. DA needs to develop a fielding policy and a commitment to user satisfaction similar to the DARCOM policy.

ANNEX A NOTES

1. LTG Donald Keith, Honorable Percy Pierre, Joint Statement before House Armed Services Committee, Feb. 23, 1979.

2. Address before the National Security Industrial Association, Washington, D.C., 16 Nov. 1979.

3. LTG Donald Keith, Honorable Percy Pierre, Joint Statement before House Armed Services Committee, Feb. 26, 1980.

4. DARCOM Sup 1 (20 June 77) to AR 700-127, 11 April 1975, Integrated Logistics Support.

5. DARCOM PAM 700-9-4, Instructions for Materiel Fielding, 1 March 1980. (DRAFT)

6. One battalion (54 vehicles) is being temporarily retained in the 82d Airborne Division. Other war reserve vehicles are also being retained.

7. GEN Donn A. Starry, Mounted Combat in Vietnam, DA Vietnam series, 1978, pp. 142-144.

8. Letter, HQ, 11th Armed Cavalry Regt., Subject: M551 Sheridan Lessons Learned During Maintenance, 8 Oct. 1970.

9. Armed Forces Journal, 5 Oct. 1970, pg. 27.

10. Major David V. Swanson, "Lessons Learned, Logistics Support - M60A2 Tank, ODCSLOG (undated but reconstructed as Oct. 1976).

11. LTG E. J. D'Ambrosio, "Readiness - Rhetoric or Reality?" Acquisition Guidelines, DARCOM PAM 310-1-5, Aug. 1976.

12. COL Frank K. Rutherford, then Commander, 1st BN, 32d Armor, interviewed at the Industrial College of the Armed Forces, Jan. 1980.

13. MAJ David Swanson, DCSLOG After Action Report.

14. "Acquisition of Major Weapon Systems," GAO Report to Congress, March 18, 1971.

15. A limited number of FAAks were delivered in 1972.

16. The issue brought up in the letter was basically resolved by a confirmation of no change in the existing policy; i.e., gaining command must program and pay for most initial support items.

17. DTG231700Z Feb 79, Subject: M60A3 Deployment.

18. TAG Letter, Subject: Skill Performance Aids (SPAS) Program, 4 June 1979.

19. PM, Manportable Common Thermal Night Sights.

20. Colonel James Ray, Chief, Force Modernization Division, USAREUR letter to author, 14 Dec. 1979.

21. Letter from Colonel Ray.

22. AR 1000-1, 1 April 1978.

23. Washington Post, March 14, 1980.

24. LTG James G. Kalergis (Ret.), Total Tank System Study and TFMG, discussed in Armor, July-Aug 1977, pp. 5-11.

25. Comments taken from the following letters: COL W. E. Davis, TSM, ITV, 11 Jan. 1980; COL C. F. McGillicuddy, TSM, Black Hawk, 3 Dec. 1979; COL Frank Day, TSM, M60A3/XM1, 30 Nov. 1979.

26. USAREUR Deployment Plan for the Improved TOW Vehicle (M901) and TOW Night Sight (AN/TAS-4), 17 Oct. 1979.

27. Letter from Colonel James Ray.

28. LTC Thomas L. Beale (Commander, 1st Bn, 32d Armor), After Action Report - M60A3, 1 Aug. 1979.

29. In January 1980 the author visited the M60A3 tank plant in Warren Mich., and asked the Plant Commander about feedback from Europe that was significant enough to warrant changes in quality control procedures. He stated that he had heard of no problems that required any changes.

30. The Navy has relied on civilian technical representatives aboard ships since before the Vietnam conflict. Although they stayed aboard during the Vietnam war, the only complaint heard was that they were making more money than the ship's captain!

31. Some of the information for this section is based on a Jan 1980 interview with LTC Larry Capps, former Commander of 3d Ordnance BN (USAREUR) and member of Patriot Project office. LTC Capps is currently a student at ICAF, Washington, D.C.

32. DOD Directive 5000.39, Acquisition and Management of ILS for Systems and Equipment, Jan. 17, 1980.

33. LTG Robert J. Baer, "Keynote Address," printed in Armor, July-Aug. 1979.

ANNEX B: System Descriptions

BLACK HAWK HELICOPTER - UH60

The BLACK HAWK is a new twin-engine helicopter that is replacing the UH-1 helicopter in the air assault, air cavalry, and AEROMEDICAL evacuation mission. This new aircraft is designed to be the Army's first true squad assault helicopter. The BLACK HAWK reduces the cost per troop mile over 40 percent. Improved reliability and maintainability will provide the Army with a low cost of ownership helicopter. With a crew of three (pilot, co-pilot, crewchief), full fuel (2350 lbs.) at 95 degrees F and 4000 ft., using 95% intermediate rated power, the salient BLACK HAWK features are:

Mission Gross Weight	-	16,450 lbs
Cruise Speed	-	147 KTAS
Endurance	-	2.3 hours
Payload	-	11 Troops/2640 lbs., with provisions for 3 additional seats
Vertical Rate of Climb	-	480 fps
Range	-	300 nm
Armament	-	2 M-60 MG
Armor Protection	-	7.62mm API and redundant critical systems

The BLACK HAWK achieved IOC in November 1979 in the 101st Airborne Division (AA) at Fort Campbell, Ky.

M198 HOWITZER

The M198 is a towed 155mm field artillery howitzer. It is air transportable by CH-47C helicopter and provides increased range, improved reliability and maintainability over the standard towed, 155mm, M114A1 and M114A2 howitzers now in use in the US Army and Marine Corps. The M198 will be employed in general support field artillery battalions and in direct support light infantry divisions. US Marine Corps will also employ this weapon in the Marine Division. In addition to firing all stockpiled ammunition items, the weapon is specifically designed to be utilized with new projectiles and propelling charges currently under development.

M198 Performance Data

CHARGE/ZONE	M119 (Z8)	M203 (Z8S)	
MAX RANGES, meters			
M107 Projectile	18,500		
M483A1 Projectile		22,000	
M549A1 Projectile		30,000	
PRECISION (% of Range Probable Error)			0.3
RATE OF FIRE*			4 rds/min-max
*As determined by Thermal Warning Device			
RELIABILITY			700-1100 Mean Rounds between failure
MAINTAINABILITY			30 min mean time to repair (organizational) 2 hours mean time to repair (DS)

EMPLACEMENT/DISPLACEMENT TIME . . . . . 5 min
TUBE LIFE . . . . . 1750 Equiv Full charge rds
AIR MOVEMENT . . . . . In addition to air movement by CH47C helicopter and C130 aircraft, the M198 has been certified for aerial delivery by LAPES (Low Altitude Parachute Extraction System) and airdrop by parachute from C130 aircraft. Its prime mover (M54 or M813 5-ton truck) can be air-moved/dropped by the same means (except by CH47C).

The M198 howitzer achieved IOC in April 1979 in the 18th Field Artillery Brigade (Abn), Fort Bragg, NC.

TACTICAL FIRE DIRECTION SYSTEM (TACFIRE) AN/GSG-10

TACFIRE is an integrated on-line tactical computer system that automates the Field Artillery functions of: ammunition and fire unit status, fire support coordination, support and geometry checks, survey computations, tactical fire control, technical fire control, fire planning, artillery target intelligence, nuclear and chemical target analysis, nuclear fire planning and fallout prediction. These functions are distributed as required by doctrine from Corps level to FA battalion level.

TACFIRE is an ADP-based command and control system including militarized hardware and a complete software package. There are computer shelters at Corps Artillery, Field Artillery group Division, and each cannon field artillery battalion level. There are remote input and/or output devices for the FA batteries, fire support teams, fire support officers, division artillery counterfire sections, the fire support element at division headquarters, and the operations/intelligence section of the cannon battalion. The computer programs (software) to automate the functions enumerated above are provided on a tape transport cartridge for loading into each computer center. Computer centers, as part of the tactical operations centers at each echelon, are interconnected using contemporary means of field communications; e.g., FM radio, wire, or VHF multichannel.

TACFIRE achieved IOC in April 1979 in the 1st Cavalry Division Artillery, Fort Hood, Texas.

M60A3 TANK

The M60A3 is a full tracked, 57.3-ton armored fighting vehicle. Utilizing a 750 HP rise diesel engine the M60A3 reaches maximum speed of 30 MPH on secondary roads and 12-16 MPH cross-country with a cruise range of 280 miles. The crew can engage both point and area targets with a main 105mm gun, a complementary 7.62mm MG and a Cal .50 MG. To insure a high degree of accuracy and minimum reaction time the M60A3 system includes a ruby laser rangefinder and a solid-state full solution ballistic computer fire control system.

The tank can operate at night by using the night vision viewer and tank thermal sight. The tank also has the following capabilities:

Smoke generator system
Deep water fording w/kit (48 inch w/o kit)
60% grade or 30% side slope
36-inch MAXIMUM vertical climb
102-inch MAXIMUM trench
375 gallons fuel capacity

The M60A3 achieved IOC in July 1979 in the 3d Armored Division in Germany.

M901 IMPROVED TOW VEHICLE

The Improved TOW Vehicle (ITV) results from the integration of two standard systems, the M113A2 Armored Personnel Carrier (APC) and the Tube-launched Optically tracked, Wire-command link (TOW) Weapon System, including the AN/TAS-4 Night Sight. These two systems are linked by the ITV Weapon Station and related components. The integration of these systems into an ITV provides increased survivability for both the crew and the TOW Weapon System as well as increased fire power by the addition of a multiple launch tube. The ITV will be utilized in various infantry and armored units to provide US Forces with long-range, protected Anti-Tank Guided Missile multiple-shot operational capabilities.

The ITV will carry two missiles ready for firing and provide for internal stowage of 10 missiles. Since the ITV provides for firing missiles from an elevated missile launcher, the system is capable of engaging targets from vehicle defilade. To accommodate a variety of firing positions and target maneuver variations, the launcher has been designed with sufficient depression, evaluation, and traverse. The ITV System is configured to provide for dismount of the TOW optical sights, missile guidance and tripod set thereby enabling their use when dismounted from the vehicle.

THE ITV system also provides for a secondary weapon by means of a pintle mounted 7.72mm machine gun, and an M243 eight-tube smoke grenade launcher mounted on the front glacis provides defensive screening.

The ITV achieved IOC in January 1980 in the 11th Armored Cavalry Regiment in Germany.

AH-1S (MODERNIZED) COBRA TOW

The AH-1S (modernized) is a two-place, tandem-seated attack helicopter, powered by a single T-53-L-703 1800 hp gas turbine engine, flat rated to 1485 shaft horsepower by the reduction gears and to 1290 shp by the transmission. This flat rating provides a significantly improved hot-day capability over the AH-1G. It has a narrow fuselage, skid-type main landing gear, a single two-bladed main rotor, and two small tapered mid wings with provisions for deploying a wide variety of armament. The outboard wing stores articulating pylons and hydraulic actuated ejector racks, which provide suspension for either one or two TOW missile launchers, each accommodating two 53-pound TOW missiles or conventional ordnance. The fuel cells are crash resistant and self-sealing.

The modification of the AH-1Q Cobra to the AH-1S configuration began in 1975. Units in Europe were equipped with the first modified AH-1S aircraft, and by early 1977 had achieved IOC. Deployment continued in FORSCOM in 1977-78. There are five different and distinct versions of the AH-1S.

TSQ-73 MISSILE MINDER

TSQ-73 Missile Minder is a van-mounted computerized air defense warning system for use with the HAWK and NIKE Air Defense systems. The system provides target detection, acquisition and tracking, and assigns and controls weapons for target engagement. Software provides for fault detection and isolation with replaceable or throw-away printed circuit boards.

TSQ-73 achieved IOC in the 32d Air Defense Command, Germany, in January 1979.

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Interviews

Author conducted about 150 interviews in the Washington area and by telephone to all parts of the country, including overseas.